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ABSTRACT

Pupils need to experience a variety of reading activities in mathematics. For all pupils, the mathematics teacher should identify unknown words from their texts and print these words on the chalkboard clearly for learners to see. Phonics should not generally be emphasized in the mathematics curriculum, but brief "teachable moments" may arise. Mathematics teachers need to provide a variety of rich learning opportunities when pupils encounter abstract symbols. Instructional procedures such as Reading Recovery and cross age tutoring can be transferred to mathematics. There are numerous excellent works of children's literature for pupils to read in mathematics. If time is available, it is good to have conferences with individual pupils pertaining to what has been read. Teachers should assist pupils to develop a mathematics glossary individually or within a committee. Some successful mathematics classrooms stress that pupils write their own mathematics problems. Teachers need to diagnose weaknesses that pupils exhibit in writing and then remedy those weaknesses. Pupils individually or in committees may write diary entries pertaining to sequential days of instruction in mathematics. Pupils can use what has been learned through reading and writing of test items in mathematics. Pupils' fears of word problems can be minimized in a variety of ways. Computer use should be an inherent part of learning opportunities for pupils. Mathematics textbooks are not good or bad in and of themselves--how good a basal text is depends upon the quality of teaching that is going on. (Contains 12 references.) (RS)

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READING IN MATHEMATICS

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There are problems in reading, unique to the academic area of mathematics. If a learner does not attain well, the problem may lie in the area of reading of subject matter. Sometimes, teachers may confuse ability with experience. Thus if a pupil is not attaining as adequately as the teacher would wish, the mathematics teacher may speak of the pupil as lacking in ability. Rather than lacking in ability, the pupil may lack background experiences which hinder in mathematics achievement. A rich background of experiences can certainly aid the pupil in attaining more optimally. I recommend very strongly that teachers provide a variety of rich experiences so that the learner may acquire knowledge and skills, as well as quality attitudes. All pupils need to experience success in the mathematics curriculum so that a better self concept evolves. Adequate background experiences should accrue so that improved reading in mathematics is an end result. Ripley and Blair (1983) wrote the following:

Reading has been defined as comprehending and learning from written materials. Facilitative reading factors facilitate the ability to read but by themselves are not reading. Functional reading reading factors are actual reading abilities and their level of development depends on the facilitative factors that a child brings to the reading situation and the instruction offered by the teacher. Teachers must analyze facilitative factors and determine if these factors are in the domain of their influence and responsibility. The areas over which the teacher has an influence should be strengthened through instructional practices.The purposes that reading serve in a school setting include instructional purposes, recreational purposes, and learning- tool purposes. Instructional purposes are found in a reading instructional setting. As children progress in reading ability, subsequent instruction builds on this reading growth. Children who have reading problems cannot be expected to improve in reading ability if reading instruction does not build on their strengths. Such children need corrective or remedial instruction to improve their reading skills so that future instruction can build on their ability to read.

The use of reading as a tool focuses on reading in the content areas. Skills used in developmental reading often differ from those used in content reading. If the students' ability to read is not sufficient for the content area learning tasks, then the tasks should be modified and reading instruction should be provided to improve students' ability

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to use reading as a tool....

Improvement in Reading

Pupils do differ from each other in quality of reading exhibited in mathematics. Ideally, a learner should be able to read approximately 95- 98 per cent of the running words encountered without any previous practice. As the learner pronounces fewer than 95 per cent of the running words correctly, comprehension will tend to go downhill. If more than 98 per cent of the running words are read correctly, recreational reading is in evidence. This kind of reading is good for leisure time reading, but not adequate for continued growth to occur in reading. Thus with an approximate 95 to 98 percent of running words pronounced correctly without previous practice, there is room for growth in learning to identify additional new words. Those whose reading level, without previous practice, is below the 95 per cent of words pronounced correctly from the content contained in the reading selection may well need additional assistance. The assistance might come in the form of help given in pronouncing words correctly in mathematics. The teacher, another pupil, or a high school student who is a member of the Future Teacher's Association (FTA) may provide this assistance. This assistance can give the help needed for the pupil to do well in mathematics. I would recommend here that a pupil be given a chance to pronounce an apparently unknown word correctly. I recommend that a learner be given about five seconds to determine the unknown word before the teacher or an aid pronounces that word. Pupils do need time to ascertain what an apparent unknown word is in terms of pronunciation. The teacher must want to develop independent readers of mathematics content.

For all pupils, the mathematics teacher should identify unknown words and print these on the chalkboard clearly for learners to see. Undivided learner attention to these new words should assist pupils to recognize them when reading from the basal. The teacher needs to be certain here that pupils are on task and receive necessary definitions for understanding the meaning of these new words. Thus success in

contextual reading may be possible for most learners. With this learning opportunity, pupils develop their reading vocabularies in mathematics to take care of the unknown words in the 95-98 running words category of words pronounced correctly without previous practice.

Should phonics be emphasized in the mathematics reading curriculum? I would answer with generally "no" it should not be. However, the teachable moment is there in which assisting a learner with a word in which an unknown consonant or vowel is in evidence may take seconds of a teacher's time to do a little bit of teaching in phonics to guide learners to read more proficiently in mathematics. As a whole, phonics instruction belongs in the language arts areas. But, increased relationship among different curriculum areas is being emphasized in teaching- learning situations, such as reading across the different academic areas. Phonetic analysis a part of the act of reading.

Carlo (1996) wrote the following pertaining to the use of recorded books for pupils:

> For many young children and poor readers, there's a substantial time lag between when they see and say a word. That lag produces slow, laborious reading that makes comprehension all but impossible. It's terribly difficult for students to recall what a passage is about when they have to spend so much effort figuring out each word.
>
> A recorded book can, in effect, do what the child is not yet able to do naturally. It verbalizes the printed words with the correct pace, phrasing, and expression. As a result students make fewer reading errors, and the possibility of forming incorrect reading patterns is diminished.
>
> Best of all, it's not necessary to record dull, simple reading materials to develop a student's sight vocabulary...

Many pupils might be assisted in reading word problems if the recorded voice is there to provide direction to pupils as the reading act progresses in solving word problems. Too frequently, pupils are unable to identify unknown words, even with the use of phonics and other word attack skills. The recorded voice, clear and concise, might well provide pupils with the assistance needed to read through and complete a problem solving experience.

Reading Abstract Symbols in Mathematics

Early primary grade pupils may benefit much from developing and reading form experience charts. These young learners need to have concrete and semiconcrete experiences involving concrete and semiconcrete learning activities. Ediger (1988) wrote:

> Following this experience, pupils with teacher guidance would present related content for the latter to record on the chalkboard or on a chart in neat manuscript letters. After the ideas have been recorded, pupils read the abstract words with the teacher pointing to the content as it is being read.

The concrete materials could consist of markers such as corn, beans, wheat, and oats seeds. These materials might also consist of real objects and children themselves in the environment. Semiconcrete materials may consist of pictures of automobiles, trucks, people, chairs, tables, among other items. The teacher here needs to be a good leader in stimulating pupils to talk about numerical values which can be recorded in an experience chart. The psychology of teaching here is excellent since pupils presented the content, they should find it easy to read after being recorded by the mathematics teacher. The subject mater pertains to their very own experiences, not something external. The teacher writes in neat manuscript letters content presented by learners. Readines for reading is there since pupils presented the ideas for the experience chart. The teacher then points to the words and phrases as the pupils read orally together with the mathematics teacher that which was printed. A word processor might be used to type the content rather than printing it. Either way, learners may see their ideas in print as they are given. Together with the teacher, pupils read the printed content. Generally, pupils desire to read the content again until the words are mastered. Here might be a good way for selected pupils in learning to read content in mathematics. The related ideas deal with content in mathematics that learners developed covering concrete and semiconcrete mathematical materials.

Starting with the kindergarten level and progressing sequentially through the ensuing school years, pupils need to read meaningfully

those numerals used in the basic four operations, the number names in word form, the abstract symbols for greater than and less than, parenthesis and brackets used in mathematics, radius, diameter, and radius squared, among other abstractions. Reading of these abstract symbols presents a unique kind of experience peculiar to mathematics alone. Thus reading the set of counting numbers — 1, 2, 3, 4, 5, 6, 7 ... represents skill in being able to read mathematics content and ideas. Or the operation of multiplication and addition that has the following expression: 3x7+5x4= .... indicates that reading is not always done in a left to right progression. Several of my teacher education students over the years have responded with 104 as being the correct answer to the above expression. A rule needs to be learned here in that operations pertaining to multiplication must be completed first prior to any operation in addition. The correct answer would then be 89 instead of 104. If a parenthesis is in evidence, then the operation is performed first pertaining to what is expressed therein, such as — 3x(7+5)x4= . The answer here is 144. In many cases then in mathematics, one does not read from left to right in sequence. There are definite rules to follow in performing operations on numbers. As additional examples, notice the following whereby generally most would start the operations from the right and move to the left: 134

x 84

—

Pertaining to the learning of rules, Kapoor (1996) wrote:

The use of the phrase, "learning to think mathematically" in mathematics is rather broad. There is no consensus on the precise definition of this phrase. mathematics is a living subject which seeks to understand patterns that permeate both the world around us and the mind within us. Although the language of mathematics is based on rules that must be learned, it is important for students to move beyond rules and express things in the language of mathematics. The transformation suggests changes in curricular content and instructional style. It involves renewed effort to focus on:

1. Seeking solutions, not just memorizing procedures.
2. Exploring patterns, not just memorizing formulas.
3. Formulating conjectures, not just doing exercises.

Mathematics instruction should provide students with a sense of

discipline – a sense of scope, power, uses, and its history. It should give them sense of what mathematics is and how it is done, at a level appropriate for the students to experience and understand. As result of their instructional experiences, students should learn to value mathematics and feel confident in their ability to do mathematics.

...mathematics instruction should help students to develop mathematical power, including the use of specific mathematical modes of thought that are both versatile and powerful, including modeling, abstraction,, optimization, logical analysis, inference from data, and use of symbols...

Mathematics teachers need to provide a variety of rich learning opportunities when pupils encounter objectives pertaining to abstract symbols. Concrete materials should be used to guide pupils in understanding abstract symbols, such as in using markers (sticks, pencils, and seeds, among others) to show meanings attached to the concept of addition — Three pencils and four pencils are how many pencils all together? This could be shown also in the semiconcrete with pictures of three pencils and four pencils, among other illustrations. In the abstract, this would read 3+4= . With the use of concrete and semiconcrete materials of instruction sequentially, learners tend to understand the abstract better in order of learning activities applicable in teaching-learning situations. When viewing the number sentence 3+4=7, primary grade pupils should read the contents as the teacher points to the words in a left to right sequence. Being able to read mathematics content with understanding is of utmost importance. Otherwise, a pupil might have wasted his/her time in reading subject mater.

It would be ideal if a teacher could always provide developmental learnings for pupils. Teachers are human beings and do have to make numerous estimates as to where pupils are presently achieving. Thus diagnosis and remediation are necessary be it in reading mathematics content or solving problems involving numeracy. Pertaining to remediation and intervention, Schmidt (1995) wrote:

In planning intervention for students, the connection between assessment and instruction can provide useful information to remediate students' concepts and skills. This action research study suggests some classroom strategies to assist in providing intervention.They are: build on students' conceptual and skill understandings, use developmentally

appropriate games and activities, and organize classroom learning centers to manage group and individual intervention experiences in the classroom.

The above guidelines should provide guidance and direction to teachers to help pupils achieve sequentially. Whenever pupils are not achieving well in reading content in mathematics, the teacher needs to determine why. There are numerous causes here. The point is to determine cause or causes and then provide learning activities in reading mathematics content which provides for optimal progress.

Some probable causes are the following:

1. lack of knowledge and skill in phonics. Here, the pupil is not able to associate sounds (phonemes) with symbols or letters (graphemes).

2. not being able to divide a word into syllables for ease of recognition of the unknown word. Thus a word becomes familiar to the learner when dividing the unknown word into component parts so it is recognizable.

3. failure to use context clues. A word supplied within a sentence must make sense in relationship to the rest of the words in mathematics content. Any pupil may be guided to think of a word being supplied in place of the unknown word to notice if it makes sense in a meaningful way.

4. ignoring picture clues. In mathematics textbooks, for example, there are illustrations, at intervals, which aid in understanding how a problem is to be worked. These illustrations may also provide direct clues as to what an unknown word is in reading mathematics content.

The mathematics teacher does become a teacher of reading since much content for pupils to learn from and study involves identifying abstract symbols such as words, phrases, sentences, and sequential paragraphs.

One on one approaches in teaching reading are being emphasized. A rather recent approach here is called Reading Recovery.
If a teacher has time, this procedure may be used in reading

mathematics content. With aid service, a Reading Recovery philosophy of mathematics might well be stressed even though it is an approach for pupils who have problems in the reading curriculum. Stimson (1995) wrote:

> Some children - in spite of good first teaching - fall behind their peers. For these children, early supplementary teaching and intervention is essential. Davidson's strongest intervention is Reading Recovery - an intense, one- to- one tutoring program for the neediest first graders.
>
> A specially trained Reading Recovery teacher uses a formal approach to tutor a student for thirty minutes, usually for a period of 12 to 20 weeks. The Reading Recovery teacher tailors each student's lesson to build on the child's individual strengths, no matter how meager, showing him or her how to broaden those skills and use them to master others.

An important point to make here is the the Reading Recovery philosophy of instruction can definitely be transferred to mathematics. A one teacher and one pupil approach is excellent for those learners who have problems in word recognition and comprehension of content or subject matter. That one teacher or aid should have a relatively easy time in securing the pupil's attention when mathematics content is being read. This approach may be used on any grade level in mathematics. The amount of time given for this activity depends upon what is needed. There are many adjustments that may be made when using Reading Recovery philosophy of teaching in mathematics. The one teacher for one pupil procedure should make for more optimal achievement.

Cross age tutoring has been used successfully by some schools in assisting pupils in reading. Thus an older pupil may guide those pupils who need help in reading mathematical content. Peer tutoring may also be involved. It may not take much time per pupil to pronounce individual words or larger units in reading subject matter in mathematics if cross age or peer tutoring is used in the classroom. The point is that the mathematics teacher needs to use procedures and methods that provide learners with the needed assistance in reading when the time is there.

Pertaining to reading and writing numbers, Reys, Suydam, and Lindquist wrote:

Reading and writing are symbolic activities and should follow much modeling and talking about numbers. That's why the NCTM Standards (1989) recommended that less attention be given to "reading, writing, and ordering numbers symbolically." The key word is symbolically. This recommendation alerts us to the danger of a premature focus on symbols. A sustained development of number sense should precede the reading and writing of numbers. This approach ensures that the symbols the students are reading and writing are meaningful to them.

Now let's consider some ways in which understanding place value helps develop the reading and writing of numbers. Let us again take the example of the number 123. We can identify the places (hundreds, tens, and ones) as well as the values of each (1, 2, 3). We know that the one means 1 hundred. We also know that 23 is both 2 tens and 3 ones and 23 ones, and that 123 is 1 hundred, 2 tens and 3 ones; 12 tens 3 ones; and 123 ones.

The writer above does not minimize the writing and reading of abstract numbers. Rather they are concerned that pupils experience an understanding of the value of each place in a number such as 123. Manipulative materials represent the concrete phase of learning. This is the easiest to understand on the pupil's part. The learner may also experience the semiconcrete or pictorial form. Both the concrete and the pictorial forms of instruction provide readiness for learner's in reading and writing in the abstract. Starting with the abstract violates pupils understating of what is taught. The abstract consists of symbols that in and of themselves are meaningless. These symbols such as +, - , X, and % become meaningful only with the concrete and the semiconcrete phases of learning. Pupils need to see the connection between the concrete and pictorial with the abstract. Retention in learning is hastened when comprehension is attached to each activity presented in ongoing lessons and units of study.

Children's Literature in Mathematics

There are numerous excellent library books for pupils to read in mathematics. In my work as university supervisor of student and cooperating teachers, I have noticed much enthusiasm for reading mathematical content. There are several reasons for this occurrence:

1. pupils have selected their very own books individually to read.

2. pupils choose library books that are interesting to the reader.

3. pupils feel little compulsion to read, but read due to intrinsic motivation factors.

4. pupils read for enjoyment and for its own sake.

5. pupils are motivated to share in small groups that which has been comprehended from reading.

The teacher needs to be on the lookout for good children's literature in mathematics. These purchased library books may be housed at one center in the classroom. The mathematics teacher should periodically introduce selected library books to learners. The purpose in making these introductions is to whet the appetites of learners for reading mathematical content. A quality bulletin board display may also encourage pupils to read and learn more mathematics. At parent/ teacher conferences the latter should tell parents about selected library books which a child might wish to read. Parents should be encouraged to read orally library books at home to their offspring in an interesting manner. There are parents who are not aware of children's literature in mathematics. I have observed parents who really became fascinated with literature in mathematics for children. It almost appeared as if parents enjoyed the library books as much as or more than the offspring. A reading table with accompanying chairs adjacent to the center with library books may assist pupils to do an increased amount of reading.

Library books should be written on diverse reading levels of pupils. Each pupil should be able to locate sequential library books to read on his/ her reading level. Generally pupils individually select library books to read that they can comprehend and understand. Books written on the frustrational level of reading are generally not selected by pupils. On the frustrational level, there are too many words that the learner may not be able to identify. The content might also be written on a level which is too complex for the reader to understand. There should be large illustrations in library books written for young pupils in particular, although there are older elementary pupils who also like to view and discuss pictures with others. The teacher should observe which books

pupils tend to read and assist in word pronunciation and identification as needed. Good readers may also assist in pronouncing unknown words to individual learners.

If time is available, it is good to have conferences with individual pupils pertaining to what has been read. Veatch (1959) was a strong advocate of individualized reading; her textbook is still a classic today for individualizing a reading program for pupils. She recommended the following:

1. The pupil choosing a library to read, from among others, at a reading center.
2. The teacher having a conference with the learner after the latter has completed reading the library book.
3. The teacher may discuss possible answers with the learner to questions raised pertaining to the involved library book.
4. The pupil reveals comprehension when participating actively in the discussion.
5. The pupil may read orally to the teacher a selection from the library book that has just been read. The learner then indicates skills possessed in reading as well as interest in the content.

The teacher may assist the pupil in any skills that are lacking in reading mathematical content. By discussing the related subject matter in the library book, the pupil elaborates on the content which might involve creative and critical thinking as well as problem solving. The basic tenets of individualized reading might well be applied to pupils reading library books on mathematical content.

A few examples will be given here of library books for pupils that stress mathematics. Clare (1992) in her book entitled A Grain of Rice has a farmer saving the life of an emperor's daughter. The farmer's reward was a grain of rice the first day; the amount of rice to be received was to double each succeeding day. How much rice would the farmer receive the 25th day? There are numerous problems that may be identified and solved from content in A Grain of Rice.

Mc Millan (1991) wrote a children's book entitled Eating Fractions. Pupils see fractional parts of different foods such as halves, fourths, eighths, and so on. Recipes, easy to make, are located in the back of the book; here pupils may assist in measuring ingredients for food preparation.

A third library book, among others pertaining to mathematics, discussed here is by Rod Clement (1990) and entitled Counting on Frank. There are numerous humorous situations mentioned in the book such as a boy calculating how many humpback whales would fit into his house.

There are numerous library books written on the developmental level of pupils when reading about content in mathematics. These library books can fascinate learners in wanting to do more reading and become highly interested in mathematics.

A Mathematics Glossary

Pupils with teacher guidance should have ample opportunities to become independent in attaching meaning to words read. With the use of context clues, the learner may ascertain the identification and meaning of a word by noticing the surrounding words within the sentence. If a pupil, for example, does not identify and know the meaning of the underlined word, the rest of the words in that sentence might take care of the unknown: "The word pi is pronounce the same way as the pie that you eat. Pi has an approximate value of 3.1417." I truly believe that most pupils would be able to attach meaning to the Greek symbol "pi" in context in these two sentences. The teacher then needs to assist learners to use context clues in reading mathematics subject matter. The use of context clues is a powerful means of recognizing new words as well as determining their meanings.

I suggest that teachers assist pupils to develop a mathematics glossary individually or within a committe. This activity indicates that pupils can be authors and be empowered with their very own writing. Arranging words alphabetically is involved here as well as the correct

spelling of words. Relevant terms need to appear in the glossary. Definitions for each word must be clear. Examples may clarify meanings of mathematics terms sooner than definitions. It would be good to use each term in a sentence within a contextual situation. If a learner forgets the definition/use of a term, he/ she may refer to the glossary. The glossary should be in loose-leaf form so that entries may be added as necessary. Pupils need to become independent in recognition of words and their respective meanings. It also saves the teacher's time when a pupil does not need assistance. The teacher might then provide help to those who need it to progress more sequentially. The mathematics glossary should assist pupils to become increasingly better readers than would otherwise be the case. Diagrams might be added to a term if this makes the meaning more clear and distinct. Mathematics does have its own unique vocabulary as well as words that intersect with other academic disciplines and yet the word may have a separate meaning pertaining to mathematics. As an example, I have noticed the following words in a glossary developed by four pupils in cooperative learning: cross products, ratios, scale drawings, similar figures, tangent/ cosine/ sine, proportion, and fractional part. The learners with teacher guidance determine which words go in to a mathematics glossary. It is obvious that a glossary will reflect the present unit being studied in mathematics. Definitions written for each word need to be clear, Each word should also be written within a sentence in order that pupils perceive contextual use of a vocabulary term.

Pupils Write Their Own Problems

Some very successful classrooms in the teaching of mathematics that I have observed stress pupils writing mathematics problems. There are learners who do an excellent job of writing mathematics problems. Numerous educators emphasize the importance of writing across the curriculum. When pupils are actively involved in writing in mathematics, increased skills in written work are then being emphasized. I copied down several word problems that pupils have written in observational visits made to diverse schools. These are following:

1. Al had three shirts and his parents bought him two more. How many shirts did Al then have? This problem was dictated to the first grade teacher who in return wrote what was stated.

2. Tony's father had fifty- two dairy cows. Six were sold. How many were left? This problem was written by a third grader who lives in a rural area.

3. During vacation time, Mary's parents drove 612 kilometers the first day, 386 the second day, 456 the third day, and 511 the fourth day. How many kilometers were driven all together? This problem was written by a fifth grader pertaining to an imagined number of days driven.

4. Bill has a circular garden. If the radius is seven meters, what is the area of the garden? This problem was written by a sixth grade pupil.

Pupils can assist each other in proofing the final written product. Problems may be written individually or within a committee. If a pupil cannot not spell words well, this should not hold back a learner from active participation in writing in mathematics. Learners should assist each other in correct spelling of words. Reading of problems written by learners can be very satisfying to many pupils. When proof reading is done, pupils tend to read critically and creatively with the intent of solving problems and that is to write clearly stated content. Pupils need to experience a variety of reading situations in mathematics. The teacher may present a mathematics situation and have learners write the problem and also solve it. A teacher had sixth grade pupils look at a cylinder, a large empty fruit container, and ask for the volume of this container in cubic centimeters. An example of the final written problem as provided by a committee was the following:

An empty fruit can is shaped like a cylinder and is 45 centimeters high. The radius of the base or circle is 10 centimeters. How many cubic centimeters does the can hold?

For early primary grade pupils, the teacher may write what learners have given pertaining to a mathematics situation. Thus if the

teacher shows two spoons in a set followed by two more spoons in a second set, how many are there all together? I have observed pupils who provided the necessary information clearly to the teacher. The teacher printed in neat manuscript letters that which the learners had presented orally for the mathematics problem. The problem in its final form can be printed in large manuscript letters on suitable paper and put away for future reading by learners. Pupils tend to like to read that which was completed previously.

When pupils write to inform or have a third party respond to written work, Evans (1984) indicates that learners do more critical thinking and are more specific in writing than would otherwise be the case in mathematics. He also advocates that pupils be involved in Trouble Shooting. Here, pupils explain in writing why errors were made in homework assignments. The pupil then reveals why errors were made. The teacher has more feedback from the learner as to why errors were made. Davidson and Pierce (1988) believe that pupils writing experiences assists them to do a better job of summarizing content as well as reflecting upon mathematics vocabulary and concepts. They also advocate that pupils engage in journal writing. In this way, pupils identify new questions pertaining to what had been learned or reflect upon previously acquired subject matter in mathematics. It is difficult to separate writing activities from the mathematics curriculum. A quality writing curriculum within mathematics assists pupils to retain, review, and think about processes and procedures involved in ongoing lessons and units of study. Stix (1994) emphasizes pupils see a relationship between manipulative materials being used in a lesson and the related numbers or symbols when being involved in journal writing. Journal writing may be the best way to assist pupils in using mathematics symbols in ongoing lessons and unit of study.

Diagnosis in Reading and Writing in Mathematics

The teacher needs to diagnose weaknesses that pupils exhibit in writing. The specifics diagnosed should then be remedied. Which errors may learners then make in written work?

1. numerals that are reversed frequently are 3, 7, and 2.

2. words or sentence parts that are reversed such as "was" for 'saw" or "He/she the numbers added" for "He/she added the numbers."

3. improper agreement of subject and predicate in writing word problems such as "He ride the bicycle" instead of "He rides the bicycle."

4. lack of proper arrangement of numerals for column addition such as the one's, ten's, and hundred's columns not aligned appropriately, thus making for errors in adding.

5. not copying a problem correctly from the basal text in order to solve it at the learner's desk.

6. failure to rename the minuend in subtraction when compound subtraction is being emphasized.

6. incorrect regrouping in compound addition when any column has a value of ten or more.

7. not identifying geometrical figures and shapes correctly so that areas and perimeters can be determined with the use of formulas.

8. incorrect procedures used in the basic four operations.

9. a general lack of neatness which hinders in responding correctly in written work in mathematics.

10. accuracy in written work not being in evidence.

There are many additional areas of diagnosis that can be mentioned here such as not writing the whole and counting numerals correctly; not using the commutative, associative, and distributive properties correctly in writing; being unable to regroup and rename in the basic four operations on number; not being able to count in writing by twos, threes, fives, and tens; not writing negative numerals correctly; and inability to attach meaning to content written.

The teacher of mathematics needs to observe daily work of learners carefully to notice errors made. Each error should be corrected unless it is minor in consequences. Accuracy, creativity, and interest are salient factors in reading and writing in the mathematics curriculum.

Diary Entries in Mathematics

Pupils individually or in committees may write diary entries pertaining to sequential days of instruction in mathematics. These entries might then be read and shared with others in the classroom setting. The following are examples of specific diary entries which are dated:

October 10. We worked on multiplying a fraction by a fraction. This appeared meaningless until the teacher showed the meaning of 1/2 times 1/2 = 1/4 . The teacher showed 1/2 of a circle. Then the 1/2 was divided into two equal parts to show the answer as being 1/4. Pupils were asked to think of how fractions can be used in everyday life. Everyone agreed that pies were divided into parts within a family and the portion size depended upon the number of family members. Then too, there are times when a part of the pie is left over for the next meal and needs to be divided among the number in the family whereby each may get a small slice indeed.

October 11. The teacher guided the class to review selected operations on fractions that had been learned previously. Thus the teacher showed pupils a cardboard pie divided into five parts. Each part was a fifth of the pie. The fifths were added to show a value of one. So one pie divided into five parts is equivalent to five fifths. This was very clear when viewing the whole pie being divided into fifths. There would then be five equal parts.

October 12. The teacher assisted us to understand that a mixed number can be changed to an improper fraction. If 1 and 1/2 circles are being considered, how many halves are there? The single circle was changed to 2/2's. Two halves and one- half can be seen as 3/2's with the use of the paper pie parts. The teacher assisted us to see practical application of division with fractions. Thus if there are five candy bars to divide among ten pupils, what fractional part does each receive? The actual candy bars or some other food items could actually be used to have learners attach meaning to the abstract fraction.

In addition to dairy entries, pupils individually or in committees may read and write log entries. Logs cover a longer period of time as compared to diary entries. A log could cover one week's amount of time given to the teaching of mathematics. The diary entries might then be used to write the log. Thus a summary of what has been learned will accrue. Logs are valuable to write due to the following:

1. main ideas need to be written to summarize content.
2. higher levels of cognition must be used by learners when writing main ideas which cover much content. For each day's recordings, one main idea should be adequate. A main idea may even summarize a week of school work in mathematics activities.
3. specifics in written work may be stressed such as legibility in handwriting, correct spelling of words, proper paragraphing, quality sequencing of ideas recorded, and neatness of the final product being in evidence.
4. logs, as well as diary entries, may be saved for future reading by pupils.
5. committee skills may be developed by learners if rules are developed prior to group endeavors. The rules need to be enforced.

The teacher should have pupils read and write for a variety of purposes in mathematics. Mathematics content is retained for a longer period of time if it is used such as in written work. Learners tend to forget that which is not or rarely used in every day life. Pupils tend to remember what has been learned if it is used in diverse ways.

Reading and Writing Test Items

Pupils can use what has been learned through the reading and writing of test items in mathematics. Multiple choice test items might be written when pupils reveal readiness factors. Each multiple choice test item usually has a stem and four responses, one of which is correct. The stem together with each of the four responses should be grammatically correct. The following model of a multiple choice item may be used by pupils:

Which of the following shows the intersection of two or more circles?

(a) the formula for the area of a circle.

(b) Venn diagrams .

(c) the commutative properties.

(d) the property of closure.

Each response must be plausible in the multiple choice test item. For example, if Mickey Mouse had been listed as a response, the concept of being plausible would have been violated. I believe the above test item makes it so that learners need to differentiate each response. Pupils should learn to write test items in mathematics to be exchanged with others to notice achievement. Learners need to be assisted to notice when trivia gets in the way of developing quality in test item writing.

Essay test items may be written by learners for others to respond to. Essay items need to be adequately delimited so that a general, clear cut answer can come from the learner. The other extreme is to write the essay test item so that it is completely factual and involves little in terms of higher levels of thinking. Notice the following essay item which is too broadly stated: Discuss addition. This item is so broad that an entire book could be written on the concept of addition. It does not delimit what a pupil is to write about addition. The following is so delimited that a fact is wanted instead of a discussion: What is the answer to 269 plus 186? This number pair could be written in a computation section of the test. The following is adequately delimited and permits higher levels of cognition: Discuss the differences in finding the area of a circle and the volume of a rectangular solid. Determine at least five differences.

Additional test items that learners may write in mathematics include matching, true- false, and completion. Peers may assist each other in proofing test items written. Improvement in clarity and meaning of each test item is vital. Improvement in reading and writing in mathematics is a salient end result.

Reading to Solve Word Problems

Word problems, also called story problems, in textbooks may provide selected difficulties to pupils. In solving word problems, a first step is that pupils comprehend the abstract symbols which make for words and sentences. Being able to read with meaning is a very first step in solving word problems. Second, pupils need to possess background experiences in solving these word problems. Background experiences provide readiness for problem solving in mathematics. Third, pupils need to understand what is being asked for in the word problem so that problem solving can come about. Fourth, leaners need to view the problem in a holistic manner in that salient ideas are needed from the entire word problem in order that solutions may be found. Fifth, mathematical operations need to be performed to arrive at an answer. The answer should be perceived as being tentative, not an absolute. Sixth, the pupil needs to reflect upon the tentative solution(s). Thus the learner looks at weaknesses that might be inherent in the solution. Peer study of the tentative answer has many benefits. Pupils must be able to explain why they did what was done in securing the necessary answer.

There are pupils who seemingly have fears pertaining to the solving of word problems in mathematics. To minimize these fears, Fairbairn (1993) made the following suggestions:

1. mathematics teachers should refer to these kinds of problems as being story problems. The content herein should be read interestingly and orally to learners.

2. local information should be placed inside of the story problems instead of content contained initially in these problems. The numerical data should be left the same; however, the names, places, and products should be given familiar names.

3. committee work on the part of learners need to be stressed so that pupils may learn from each other.

4. pupils should write their own story problems for peers to solve. This will take away much of the anxiety in working with these kinds of problems. Why? Pupils will realize that they too can write story problems.

5. teachers should use interesting subject matter inside the story problems so that basic mathematics skills are learned. Positive attitudes should be an important end result of this activity.

Computer Use in Mathematics

Computer use should be an inherent part of learning opportunities for pupils so that objectives might be attained more effectively. Carefully selected programs which emphasize simulation may benefit learners much in the area of problem solving in mathematics. Tutorial programs can guide pupils to achieve new facts, concepts, and generalizations sequentially in ongoing units of study. Drill and practice programs should assist learners to review what has been acquired previously. Diagnosis and remediation programs attempt to pinpoint that which has caused difficulties for learners in ongoing lessons and units of study. Remedial work should follow the point of diagnosis. Games in terms of mathematics programs provide enjoyment in learning in mathematics as well as extend content studied previously. Each program should assist pupils to attain sequentially and meaningfully. Interest in learning mathematics is vital and salient. Certainly, the mathematics teacher needs to be a good organizer of instruction to have pupils use technology effectively along with other materials of teaching and learning.

When readiness is in evidence, pupils need to experience the use of the word processor in writing as well as in reading of subject matter in mathematics. Pupils individually and in committees may write and solve problems appearing on he monitor or screen. These problems have been composed by pupils. If pupils do not possess keyboard skills, the teacher may do the typing for pupils. It is good practice for pupils to be actively engaged in writing mathematics problems for others to solve. Perhaps, these problem ares come from the real world of buying and selling of a learner. Lifelike problems stated by individual pupils when I have visited classrooms as university supervisor of student teachers

have been the following:

1. a pupils bought a cap for $4.99 plus 6% sales tax. How much did the cap cost? The pupil gave a ten dollar bill to pay for the cap. How much change should he receive?

2. a pupil who grew sweet corn in the family's garden plot had thirty corn ears to sell. Each was priced and sold for 12 cents, how much the corn sell for?

3. a pupil in a small town sold lemonade on a hot day in summer. Ingredients for the lemonade cost $3.10. Paper cups cost a total of $.70. Forty-five cups of lemonade were sold at $.20. How much money did the pupil make selling lemonade?

Mathematics problems do not always, of course, need to come form the real world. I have observed pupils who do a good job of simulating problems from the real world using a word processor. These pupils individually or in committees appear to be creative and can write realistic problems in mathematics. I have observed others who solved these problems to engage in critical thinking and reason logically in order to solve problems.

In Closing

Pupils need to experience a variety of reading activities in mathematics. There are commercially published materials for pupils to read. These should be on the understanding levels of individual learners. If the reading level therein is too complex, the pupil will not comprehend the contents. Feelings of frustration and failure may be an end result here. Should the commercial reading materials be too easy to read, boredom and a lack of challenge may enter in. With individualized reading, a pupil may choose which books to read and which to omit.

There are numerous opportunities to read what pupils have comprehended from a variety of concrete and semiconcrete experiences and put in written form. Here reading and writing become one, not separate entities. What has been written may be saved for future reading by learners. Adequate background experiences assist pupils to be able

to record ideas in written form. Learners need to practice the skill of reading so that it is continually refined. Mathematics has its very own terms that are unique to this academic discipline. It also has its own areas of concern, such as problem solving, which makes it imperative that learners learn to read mathematics content with meaning and understanding.

Mathematics textbooks are not good nor bad in and of themselves. How good a basal text is depends upon the quality of teaching that is going on. I have observed student teachers and cooperating teachers who have done an excellent job of teaching mathematics using the basal textbook, along with other materials used to clarify and extend experiences. The mathematics teacher needs to be certain that each pupil can read and understand the content in an adopted single or multiple series of texts. Readiness activities should be provided for pupils prior to their reading abstract subject matter. Thus the teacher may use several approaches here. One being to read over with the pupils mathematics content before pupils work exercises contained therein. Second, a peer or and older pupil might assist the learner who had trouble reading the inherent content. A tape recording may also be made of the word problems so that those who have difficulty reading may listen to the tape and follow along in word recognition from their basal mathematics textbook. One pupil- one teacher in tutoring may be necessary to have pupils individually read the subject matter with adequate comprehension.

Mathematics teachers and aids may need to assist pupils during time devoted to reading instruction with phonics, syllabication, pictorial clues, context clues, and configuration clues (viewing the shape of form of a word in comparison to other words) in order that unknown words can be identified by the learner. What happens beyond that is of utmost importance and that being learners

1. comprehending what has been read.
2. applying and using information as needed in school and in society.
3. analyzing to separate relevant from irrelevant information useful

in a given situation.

4. synthesizing content after analysis so that application can be made in more specific situations involving mathematics.

5. evaluating the solution to a mathematics problem after analysis and synthesis.

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